BLACK BOX NETWORK SERVICES

VX-HDV-IP
VX-HDV-IP-SDI
VX-HDV-IP-HDMI
VX-HDV-IP-AUDIO
VX-HDV-IP-RM
VX-HDV-IP-PSU

HD over IP Encoder/Decoder

Provides first-class HD video transmission.

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FEDERAL COMMUNICATIONS COMMISSION and INDUSTRY CANADA
RADIO FREQUENCY INTERFERENCE STATEMENTS

Class B Digital Device. This equipment has been tested and found to comply with the limits for a Class B computing device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. This equipment generates, uses, and can radiate radio frequency energy, and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or telephone reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult an experienced radio/TV technician for help.

Caution:
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

To meet FCC requirements, shielded cables and power cords are required to connect this device to a personal computer or other Class B certified device. This digital apparatus does not exceed the Class B limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.
Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de classe B prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

Normas Oficiales Mexicanas (NOM) Electrical Safety Statement

INSTRUCCIONES DE SEGURIDAD

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.
2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.
3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.
4. Todas las instrucciones de operación y uso deben ser seguidas.
5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc.
6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.
8. ervicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.
9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.
10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.
11. El aparato eléctrico deberá ser connectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.
12. Precaución debe ser tomada de tal manera que la tierra fisica y la polarización del equipo no sea eliminada.
13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.
14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.
15. En caso de existir, una antena externa deberá ser localizada lejos de las lineas de energia.
16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.
17. Cuidado debe ser tomado de tal manera que objectos liquidos no sean derramados sobre la cubierta u orificios de ventilación.
18. Servicio por personal calificado deberá ser provisto cuando:
    A. El cable de poder o el contacto ha sido dañado; u
    B. Objectos han caído o líquido ha sido derramado dentro del aparato; o
    C. El aparato ha sido expuesto a la lluvia; o
    D. El aparato parece no operar normalmente o muestra un cambio en su desempeño; o
    E. El aparato ha sido tirado o su cubierta ha sido dañada.

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1 Technical Specifications

Encoder/Decoder (VX-HDV-IP)

Compression process	JPEG2000
Video resolution	max. 1920 x 1080P, min. 640 x 480I
Delay per device	≈ 1.5 frames (=25 ms @ 60 Hz)
Total delay	≈ 3 frames (=50 ms @ 60 Hz) + network delay
Frame rate	max. 72 Hz, min. 24 Hz
Pixel clock	max. 150 MHz, min. 25 MHz
Color depth	12Bit / component
Audio channels	16 in same direction as video ** 16 in opposite direction to video **
Audio sampling rate	max. 192kHz
Audio coding	max. 32 Bit, uncompressed
Network interface	10/100/1000BaseTX, 1 x RJ45
Data interface	USB 2.0, 1 plug type A, 1 plug type B
Power supply	2x 12VDC +/- 10%, 13W
Operation temperature	-10°C to 60°C
Dimensions	211 x 210 x 41.5mm, Weight 1.3 kg (not including interface module)
Management	Internal web server

HDMI / DVI / VGA card (VX-HDV-IP-HDMI)

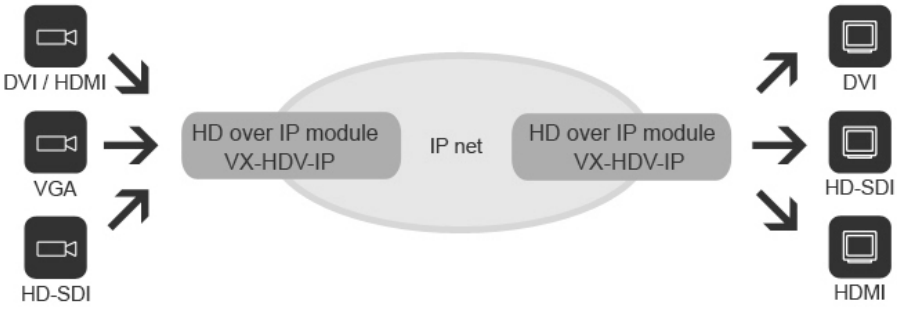
Version	HDMI 1.3
Plug	DVI-I
Ports	1 x video in (for encoder), 1 x video out (for decoder)
HDMI interface	Adapter plug included
DVI interface	direct connection
VGA interface	VGA signal receivable but not transmittable

HD-SDI card (VX-HDV-IP-SDI)

Max. resolution	3G-SDI (SMPTE424M)
Plug	BNC
Ports	1 x video in (for encoder) or gen-lock 1 x video out (for loopback) 2 x video out (for decoder)

Audio card	
Audio frequency range	20Hz – 20kHz
Audio channels	Encoder: 2 x audio in, 2 x audio out Decoder: 2 x audio in, 2 x audio out
Audio interfaces	Line-In and Out, Mic-In, Headph.-Out and RS-232-Interface

2 Overview



2.1 Summary description

The VX-HDV-IP modular JPEG 2000 IP encoder/decoder system for HD video and audio is configurable as encoder or as decoder. Two different video interface modules are currently available: DVI-I and 3G-SDI. HDMI and VGA transmission is also possible by means of simple converters.

A separate audio interface is available to enable one bidirectional audio channel for an Intercom connection.

2.2 Special features

Thanks to HD image quality, the system is ideally suited for professional applications. The modular video interface also enables interface mixing within the same installation, such as from an HD-SDI source to an HDMI device.

The VX-HDV-IP is an independent encoder that delivers full HD 1080p/60Hz video streams without any quality impairment via conventional 10/100/1000 BASE-T networks. VX-HDV-IP encoders/decoders can be simply interconnected via existing networks (LANs and WANs) as well as by Internet.

The VX-HDV-IP functions equally well in point-to point or in point-to-multipoint connections.

2.3 How it works

The encoder receives and compresses the incoming HD video signal and transmits it via LAN or WAN. The decoder decompresses and passes on the original video signal to the device connected. With adequate LAN/WAN bandwidth, the signal quality is not reduced. And thanks to the JPEG 2000 compression process, the image is not affected by artefacts or stutter. System delay (latency), network delay not included, is less than three frames. Multicast is supported, which means the image from one source can be simultaneously displayed on several monitors. The connections between encoders and decoders are defined by simple IP-addressing, enabling easy re-switching of connections without the need of crossbars.

2.4 Plug-in connections

- Slot for video interfaces (DVI-I or 3G-SDI)
- Slot for audio input/output (not yet available)
- Redundant power input 12 VDC
- Alarm switch contact
- Two USB connections ([1] USB-A, [1] USB-B)
- Console port (USB plug)

2.5 Scope of delivery

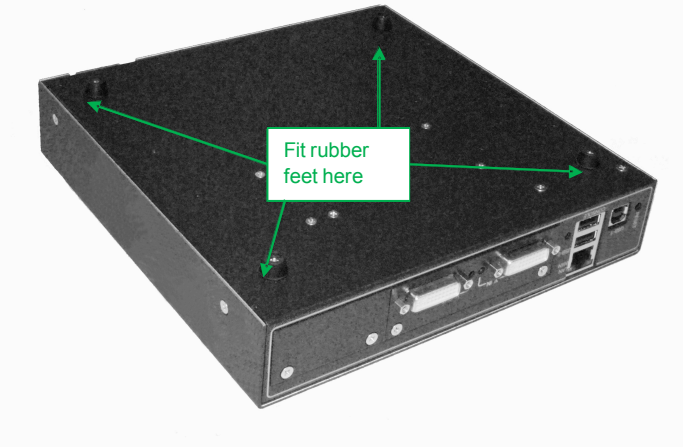
- VX-HDV-IP basic housing
- (4) rubber feet for tabletop version
- Video board (DVI-I or 3G-SDI, as required)
- 12 VDC external power supply (optional)
- 19-inch rackmounting kit (optional)

3 Installation

The VX-HDV-IP is intended for indoor installation. The operating temperature limits are -10° C to +60° C. Two or more devices stacked above each other must be adequately spaced to ensure sufficient cooling.

3.1 Tabletop version

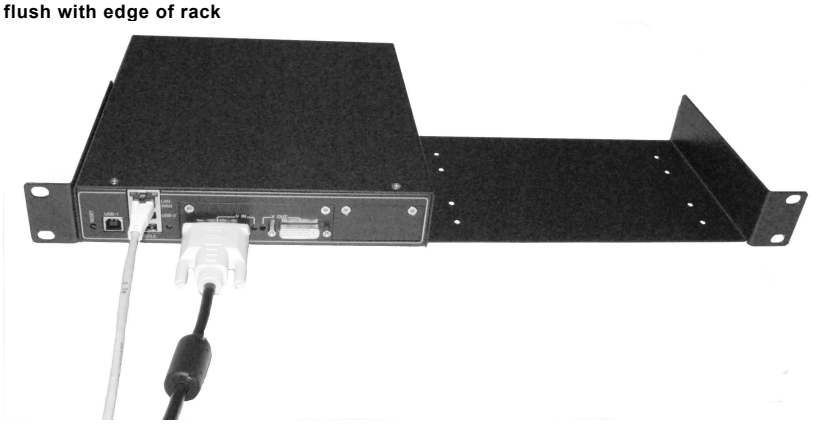
For tabletop use, the VX-HDV-IP must be fitted underneath the housing with the four screw-on rubber feet supplied.



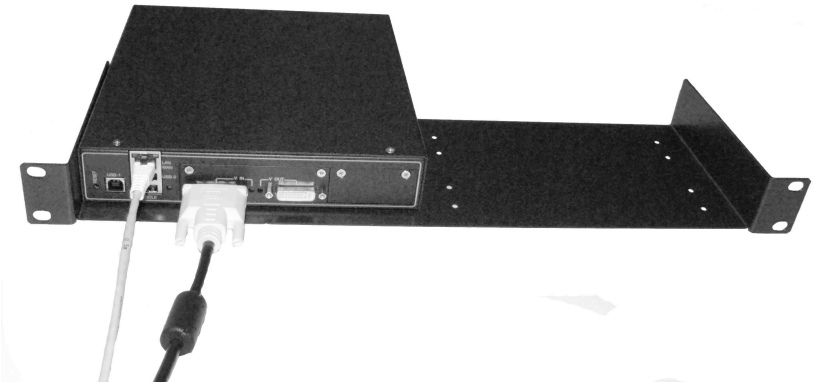
3.2 Rack-mounting version

The VX-HDV-IP is dimensioned so that two devices fit together in a 19-inch rack. For this, the optional rack mounting kit is required (VX-HDV-IP-RM). The VX-HDV-IP only needs one HU and can be fixed with four screws in various positions:

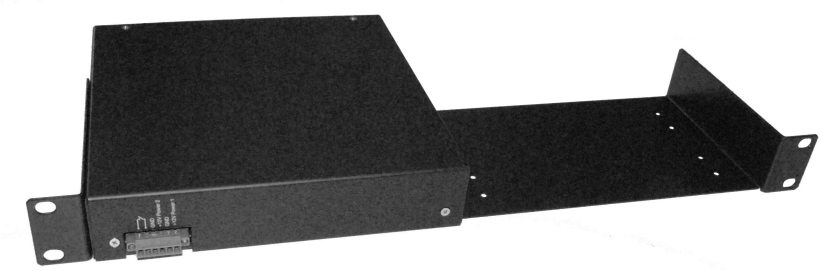
**Front connections,
flush with edge of rack**



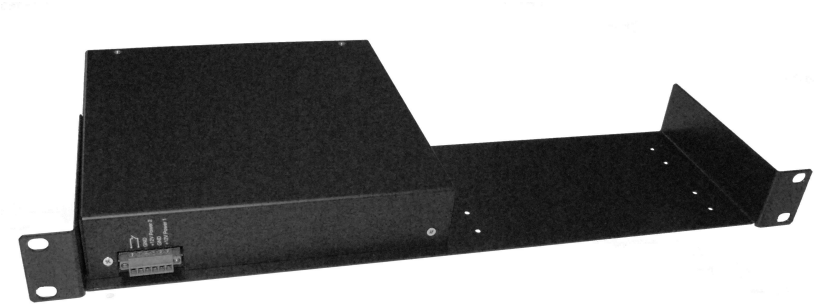
Front connections, set back approx. 2 cm (for plug protection)



Rear connection, flush with edge of rack



Rear connection, set back approx. 2 cm

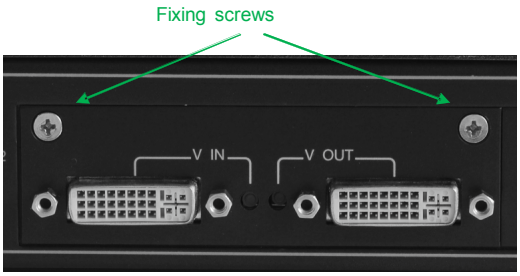


3.3 How to change and insert the video interface modules

These modules are fixed with two screws. To change a module, release both screws and carefully remove the module.

When installing a module, make sure that the board is supported on the guiderails at each side, and insert the module precisely in the straight or horizontal position until the connector engages.

→ Always shut the power off before changing modules!

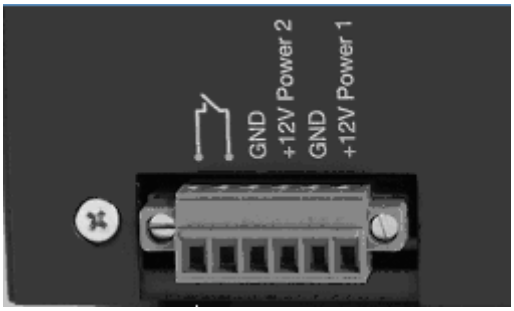


3.4 Power supply and switch contact

To activate the VX-HDV-IP, a 12-VDC/2-A power supply is required.

The two separate power input connections on the back allow for a redundant power supply. If you only use one power supply, you can connect it to either of these inputs.

The switch contact is used for monitoring the two power inputs. It closes to signal a power failure, for example, to a control system.



4 Description

The basic housing has a 10/100/1000TX Ethernet connection and two USB ports (USB 1 and USB 2) for KVM applications.

The console port is exclusively for maintenance work and is not user-accessible.

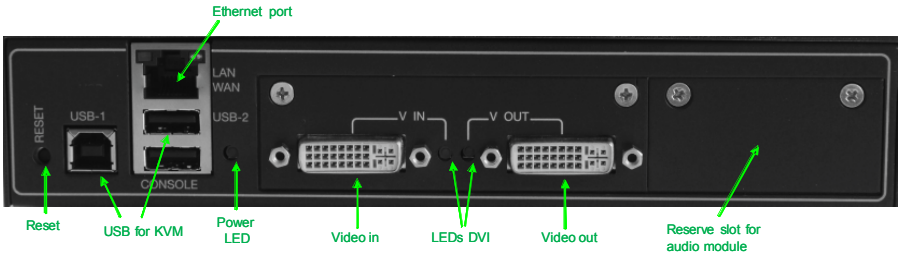
The reset button on the left returns the device to factory default setting if required. Press this button for at least five seconds until the green power LED starts flashing to signal a reboot.

The DVI module has two connections: Video In and Video Out. The VX-HDV-IP can be configured as an encoder or as a decoder. Only one connection can be activated at a time.

→ The quality of the video cable can influence the video image quality.

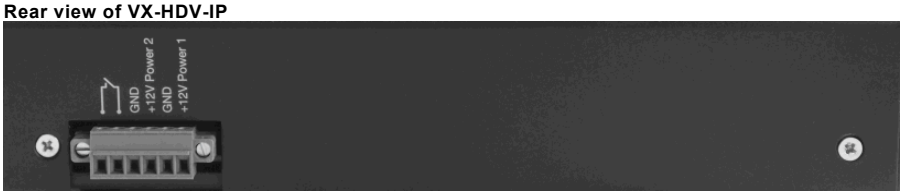
The LED of the configured port stays red if no connection is detected. This indicates whether it is configured as an encoder or a decoder, because the LED only goes green if the VX-HDV-IP detects a recognizable connection. The port is then ready for use.

Front view of VX-HDV-IP with DVI module



The VX-HDV-IP has two 12 VDC power inputs; one is redundant. Both power inputs are monitored by a switch contact that closes to signal a power failure, for example, to a control system.

Rear view of VX-HDV-IP



Status LED

LED	Color	Status	Description
Power LED	green	on	Ready for use
		off	No power
		Flashes every 3 seconds	Ready for use, but not on line
		Flashes every second	Ready for use and on line, but no video stream
		Flashes every 0.2 seconds	Booting after hardware or software reset
	red	Flashes every second	Identifying device (see 5.2: System Configuration)
left LAN port right	yellow	On	Network detected
		Flashing	Data transmission
		Off	No network
	amber	on	Connection speed 10/100 Mbps
	green	on	Connection speed 1000 Mbps
DVI port	green	On	Device connected, streaming (transmitter only in case of EDID reception)
		Flashes every 3 seconds	Device connected, video streaming but no audio (receiver only)
		Off	Not connected
	red	On	Connection active, but no device present or ready
		Rapid flashing	Identifying device (see 5.2: System Configuration)

5 Web interface

5.1 VX-HDV-IP system start-up

The VX-HDV-IP is delivered with a preconfigured IP address. Before start-up, the IP address must be reconfigured and the device defined either as encoder or decoder (the two functions cannot be used in parallel).

- Connect the Ethernet port (RJ-45) of the VX-HDV-IP with shielded CAT5e cable to a Ethernet switch or network.
- Connect the monitor to the Video Out port.
  or
- Connect the video source to the Video In port.

Access via Web browser

Default settings:

IP address	192.168.001.200
Subnet mask	255.255.255.000
Gateway	192.168.001.001

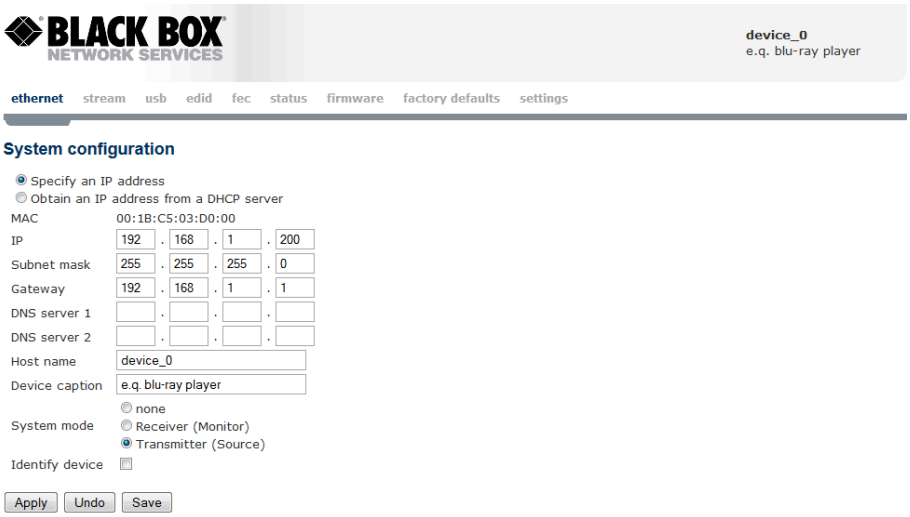
Per default, the devices are configured so that no password is required.

5.2 Ethernet

In the first register, you can define the IP address, the subnet mask, and the gateway. You can also allocate an IP address from the network by activating the DHCP checkbox. Before activation, make sure a DHCP server is present in the network. Two DNS server addresses can also be defined.

For easier identification, you can also assign a name to the device and designate a caption.

The default name is “device_0” and the device caption is “e.q. blu-ray player.”



After entering the network data, define the system operating mode of the device—either as receiver or transmitter—by checking the box next to System mode in the screen.

To distinguish between several VX-HDV-IP devices in a rack, activate “Identify device.”

All the LEDs in the device you want to identify will then flash red.

Press the “Apply” key to confirm and activate your changes. If everything works correctly, press “Save” to finalize all changes.

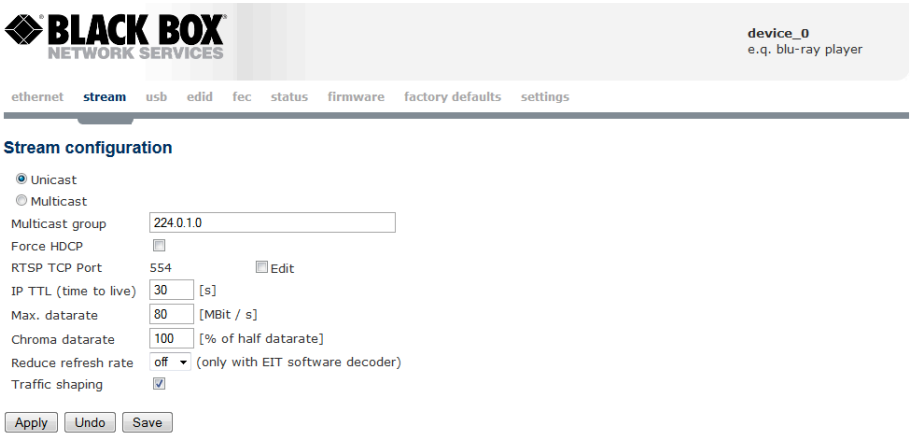
This ensures that your new settings will still be active after a reboot.

Press “Undo” to cancel a command without saving.

5.3 Transmitter stream settings

You can either set up a point-to-point connection (unicast) or a multicast connection to video stream receivers in the network that support the multicast address.

For connections that need to pass through firewalls, the RTSP TCP port can be separately defined. To avoid unnecessary network loading, the video stream size can be defined by setting a maximum data rate, for example, 80 Mbps (see below). For an optimal HD video stream, the data rate setting should not be less than 30 Mbps. With “Auto stream” activated in the stream configuration checkbox, the video stream starts as soon as a connection between two units is made.



For additional security against eavesdropping, activate “Force HDCP” (High Definition Content Protection) to protect video streams that are not from HDCP encrypted sources. HDCP encrypted sources will always be transmitted with HDCP encryption. This feature must be selected only at one device to be activated.

Chroma Data Rate

This menu item uses the available bandwidth optimally for color (chromaticity), then brightness (luminance). If the brightness is more important than the color, the proportion of Chroma can be reduced.

When Chroma is set to 100%, 50% of the bandwidth is used for Chroma and 50% is used for Luma (brightness of the image points). In the extreme case (black/white picture), only half of the set bandwidth is used because Chroma generates almost no data.

When Chroma is set to 50%, 25% of the bandwidth is used for Chroma and 75% of the bandwidth is used for Luma.

When Chroma is set to 0%, 100% of the bandwidth is used for Luma.

IP TTL (time to life)
This is a mechanism that limits the lifetime of data in a network. Once the prescribed timespan has elapsed, data is discarded.
The range is between 0–255 seconds.

Reduce the refresh rate
In connection with the software decoder of EIT, the refresh rate can be reduced, so that only every second or every third or even only every 4th image is transferred. Thus, the data volume gets smaller and the computer that is running the software uses less CPU power.

Traffic shaping
Traffic shaping is a form of rate limiting. Use it to optimize or guarantee performance, improve latency, and/or increase usable bandwidth.

Possible range for Max datarate is: 1–800 MBps
If the max data rate is set as 30 Mbit/s and you change it to 70 Mbit/s, for example, with a resolution of 1080i, the stream will stop and rebuild a new stream. This is because if we have a stream <50 Mbit/s we need only two compression chips. If the stream is bigger than 50 Mbit/s, we need four compression chips. The transmitter has to inform the receiver (when rebooting) that now it has to use four compression chips.

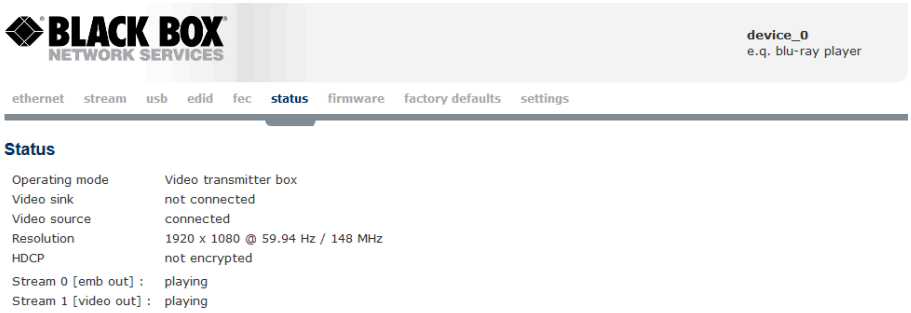
→ The maximum data rate for interlaced resolutions, such as 1080i, must not exceed 140 MBps.

5.4 Transmitter status reports

The example below shows a VX-HDV-IP with activated media player (no HDCP encryption).

Operation mode:	The device is configured as video transmitter box (vtb)
Video sink:	No monitor is connected
Video source:	connected to activated media player
Resolution:	Video stream resolution, frame rate, and pixel frequency

Stream 0 (Video out):	Playing = video stream currently sending
Stream 1 (Audio out):	Playing = audio stream currently sending



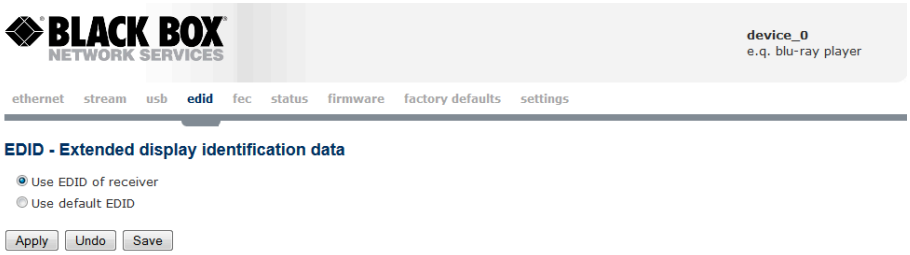
Checking the video source

If the unit is configured as transmitter and one source is connected to the video-in port, all video-out ports are loopback active and you can see the stream.

5.5 Choose the receiver's EDID

By default, the transmitter requires the EDID of the sink (e.g. monitor), so that the best possible resolution the receiver can handle is delivered. When an EDID is received, the transmitter sends a video stream. If the sink cannot send an EDID, the transmitter has to be set to "Use default EDID." The video stream is then sent with the same resolution as the video source.

On Multicast modus, the EDID is set automatically as "use default EDID." Be sure that all monitors support the settings from the source.



5.6 Receiver stream settings

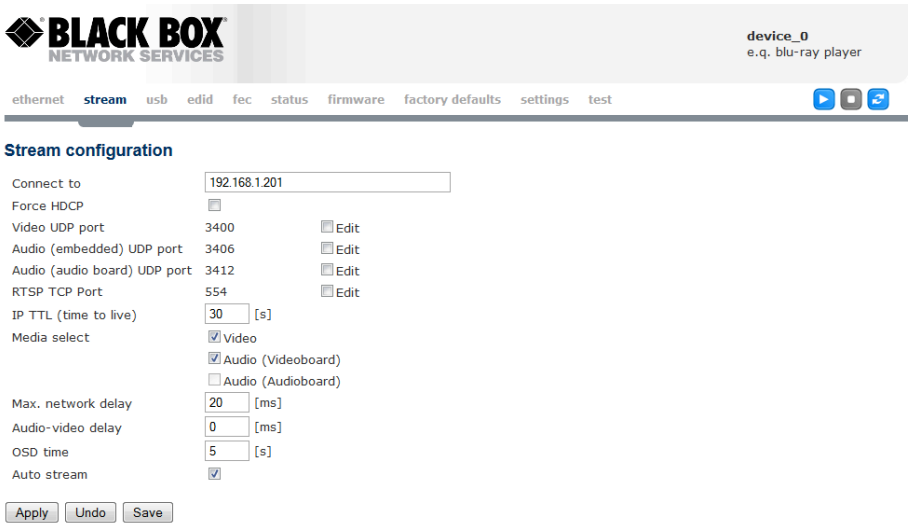
The receiver must also know where the video stream is coming from, so the transmitter IP address must be entered accordingly.

If “Force HDCP” was activated on the transmitter, it must not be activated on the receiver. It is sufficient if it is only activated on one device.

As with the transmitter, the different ports can also be manually adjusted on the receiver. Here again, the port details settings must be the same for transmitter and receiver to enable transmission.

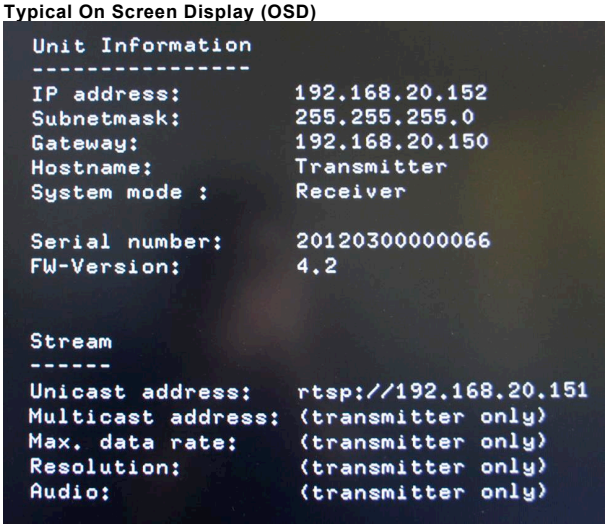
Depending on the network constellation, the maximum network delay for transmission must be set accordingly. With large networks, it is better to set a longer delay so that the video stream is temporarily stored before transmission. This ensures a constant video stream even in the case of complex networks. Changing the maximum network delay reboots the connection and interrupts the video stream because the buffer has to be read in again.

Since the video and the audio stream is not processed identically—video stream is compressed, audio stream is not— there may be delays in the transmission of sound and image. To achieve a lip-synchronous transmission, the “audio-video delay” can be adapted with values between 100 ms and 100 ms. Here, too, the change of this size reboots the connection because the buffer has to be read again.



The OSD (On Screen Display) setting defines how long information is shown on the monitor. The setting range is 0–100 seconds. At 0 setting, nothing will be displayed, and at 100 setting the display remains on screen.

Typical On Screen Display (OSD)

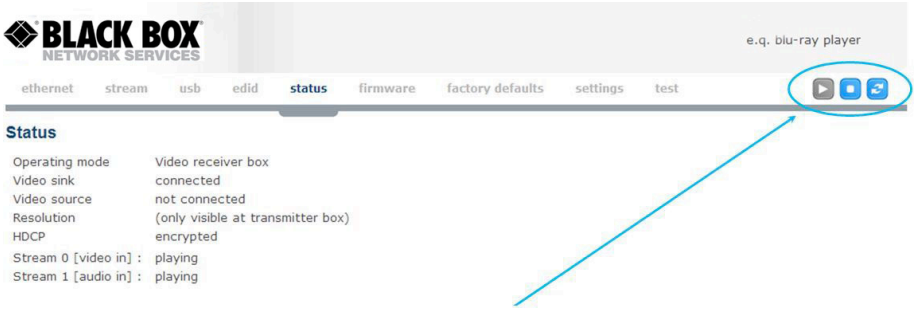


5.7 Receiver status reports

The example below shows a VX-HDV-IP with an activated monitor.

Operation mode:	The device is configured as video receiver box (vrb).
Video sink:	A monitor is connected and activated.
Video source:	No video source is connected.
Resolution:	Only displays on the transmitter box

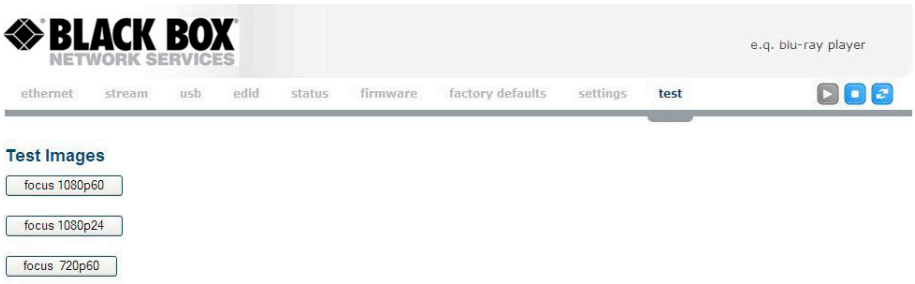
Stream 0 (Video out):	playing = video stream currently sending
Stream 1 (Audio out):	playing = audio stream currently sending



The three keys at the top right corner are for starting, stopping, or reconnecting the video stream.

5.8 Receiver video interface test

You can test the video output interface's quality and function on the DVI board at three possible resolutions: 1080p60, 1080p24, and 720p60.



5.9 Firmware upgrade

1. Save the new firmware as example “image_v4_02.img” file in a folder on the computer from where the update is executed.
2. Connect to the VX-HDV-IP via a Web interface.
3. Select “Firmware” in the Web interface menu.

4. Activate the icon “select a file” and press “Apply.” A new folder will open.

5. Select “Search” to get the “image_v4_02.img” file.
6. Click “Upload.”
7. An upload progress bar is now displayed.
8. After about four minutes, the firmware is upgraded and ready to reboot.

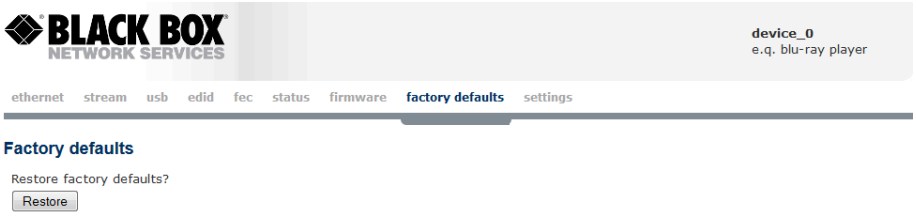
5.10 Factory default restore

Here, you can reset the VX-HDV-IP encoder/decoder to factory defaults if required.

The network details, names, and designations are restored to factory default settings. Pressing the reset button on the front of the device for >5 seconds has the same effect.

The factory default settings are as follows:

IP address	192.168.001.200
Subnet mask	255.255.255.000
Gateway	192.168.001.001
Username	admin
Password	admin
Host name:	device_0
Device caption:	e.q. blu-ray player
System mode:	none
Max. data rate:	80 MBps

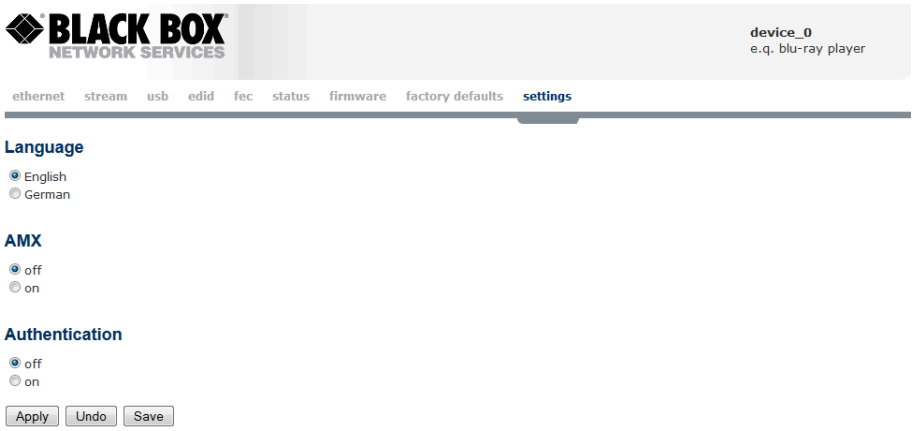


5.11 Settings

Here you can choose German or English as the system language, and define or change the user name and password for access authentication. To use the VX-HDV-IP with AMX devices, AMX must be activated.

With authentication activated, you can no longer access the device if you forgot your user name or password.

To re-enable access, reset the device to factory default by pressing the reset button on the front for at least five seconds.



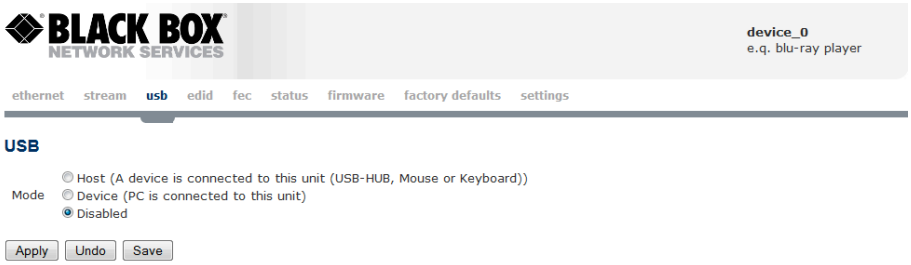
6 USB ports

Each VX-HDV-IP device has two USB-A ports, and a USB-B port for future use with KVM. The current USB port supports only the features for keyboard and mouse.

Each VX-HDV-IP unit can be configured as a host or as a device. Just activate the function you want. The USB cable length is maximum 3 m.

If you configure the unit as a host, the USB-2 interface will be active and you can connect a keyboard or a mouse to it.

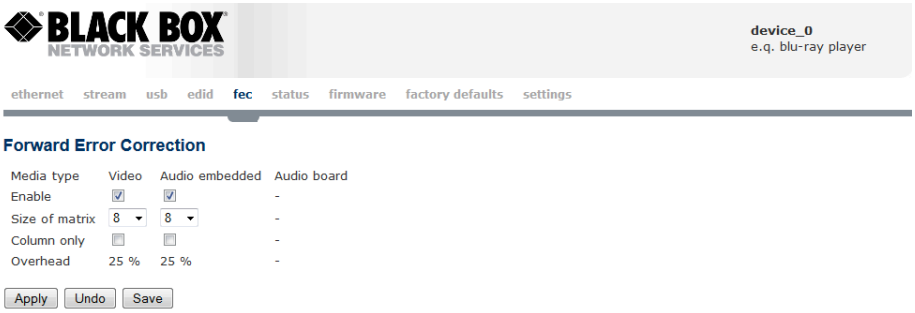
If you configure the unit as a device, the USB-1 interface will be active and you can connect it to your PC.



7 FEC Forward Error Correction according to SMPTE 2022-1

In telecommunication, information theory, and coding theory, forward error correction (FEC) or channel coding is a technique used for controlling errors in data transmission over unreliable or noisy communication channels. The central idea is the sender encodes their message in a redundant way by using an error-correcting code (ECC).

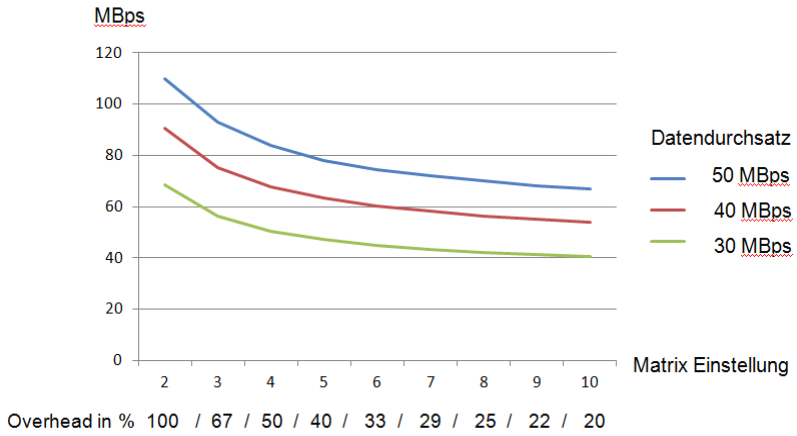
The redundancy allows the receiver to detect a limited number of errors that may occur anywhere in the message, and often to correct these errors without retransmission. FEC gives the receiver the ability to correct errors without needing a reverse channel to request retransmission of data, but at the cost of a fixed, higher forward channel bandwidth.
The FEC doesn't support the audio from the external audio interface.



FEC Enable: for video and audio separately selectable
Size of matrix: settings between 4 and 10

To calculate the redundant packets, all packets to be transmitted are placed in a matrix. The size of the array determines how many packets can be recovered. The smaller the matrix, the more bandwidth is provided to the redundant packets (= more overhead) and more packets can be recovered. But the larger the matrix, more packets must be buffered before sending, so the latency is greater. The lower the bandwidth, the greater is this effect.

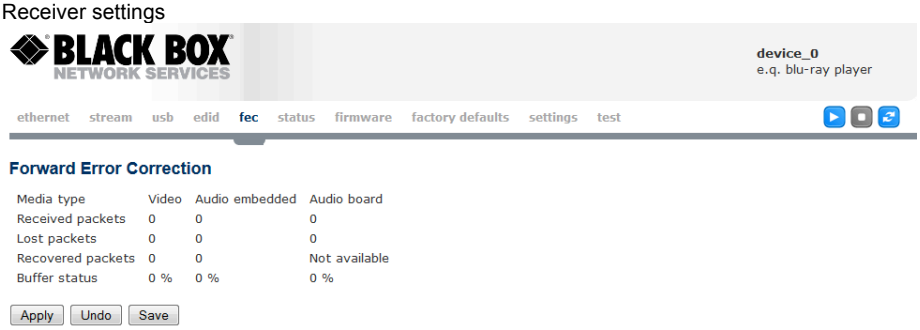
e.g.: low bandwidth (1 frame = 17 Ethernet packets) and a size of 10 x 10, 6 images need to be cached before the redundant packets may be calculated. Thus, at 60 Hz refresh rate, the network delay at the receiver to 1/60 Hz * 6 = 100 ms must be increased to ensure the restoration works. With a high bandwidth (1 picture = 250 Ethernet packets), the additional delay is only 1/60 Hz * 100/250 = 7 ms. In the example with set low bandwidth (1 frame = 17 Ethernet packets), the die size is set to 4 x 4, so only one image needs to be cached, thus the additional delay is only 17 ms.



Column only: If enabled, SMPTE 2022-1 Level A; disabled, Level B. Level A sends only one FEC stream, so only single packets are recovered. The overhead is smaller than for Level B. For Level B, in addition, several consecutive packets can be restored (it is at most as many as for “Size of matrix” set). Overhead in %: Depends on the matrix size, see table.

Overhead: The spectrum additionally required when FEC is turned on. If the bandwidth is set to 100 Mbit (= 40% overhead), and a 5x5 matrix increases the total bandwidth to 140 Mbit, the overhead is calculated as follows:
Column only switched on:
Overhead = 1 / "size of matrix"
= For example size of matrix = 5, overhead = 1/5 = 0.2
Column only off:
Overhead = ("size of matrix" + "size of matrix") / ("size of matrix" * "size of matrix")
= For example size of matrix = 5, overhead = (5 +5) / (5 * 5) = 0.4

Receiver settings



Restrictions: An additional audio board is not supported by FEC, but how many packets are not recovered is visible.

Measured Bandwith according to different Matrix settings

FEC-Matrix	Overhead	Latency by 30 Mbps	Latency by 50 Mbps	Latency by 80 Mbps
5	40%	24 ms	20 ms	18 ms
8	25%	35 ms	30 ms	27 ms

→Firewall: you have to set the video-port n and also the ports n+2 and n+4

8 Hardware reset instructions

On the front of the VX-HDV-IP is a slightly recessed reset button. To reboot the device, press this button for **less than five seconds**. Pressing it for longer than five seconds resets everything (IP address, user name, and password) to factory default.

9 Console ports

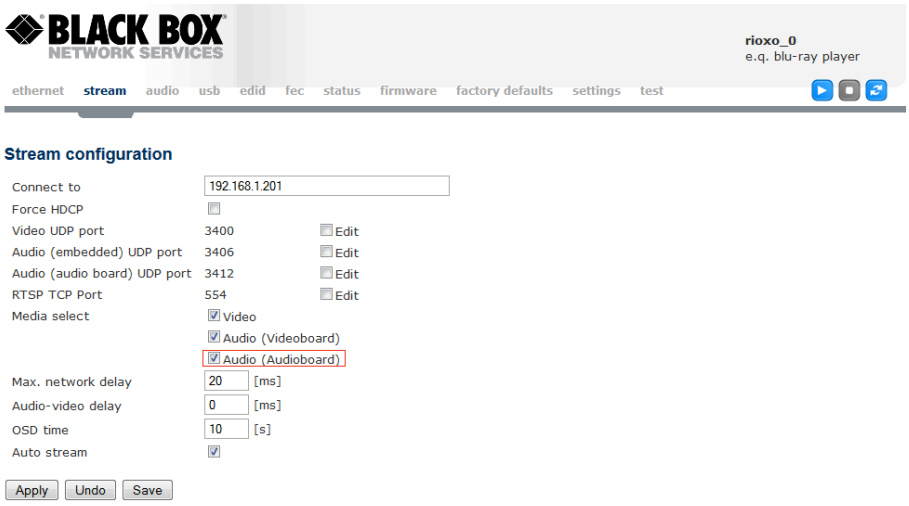
The console port is exclusively for use by Black Box Technical Support.

10 Audio-Board

The optional audio board has two line-in interfaces, Lin-In and Mic-In and two line out-interfaces, Line-out and Head-out. It also has a serial interface for future use.

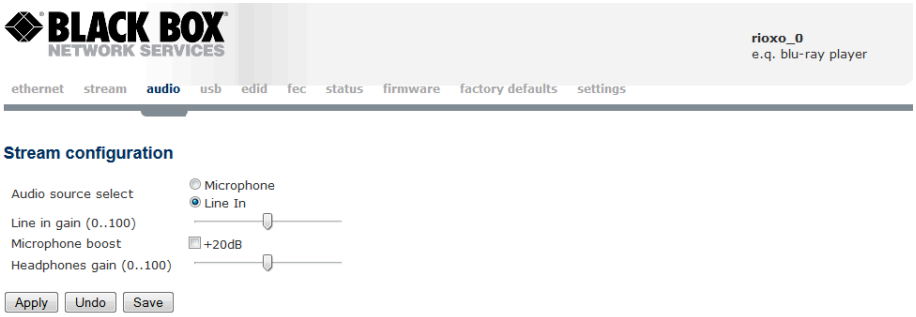
In this firmware version, the audio interface works only as an intercom solution. It builds a bidirectional audio-channel between a transmitter and a receiver.

To activate the audio function, select the “audio” (audio board) icon in the “stream” folder on the receiver unit.



This audio stream will be streamed parallel to the video/audio-stream from the main board. The stream is not compressed and HDCP and FEC have no functionality in this stream.

In the folder “audio,” select whether “Line-In” or “Mic-In” should be active. You can also adjust the gain and boost the Micro-In with +20 dB.



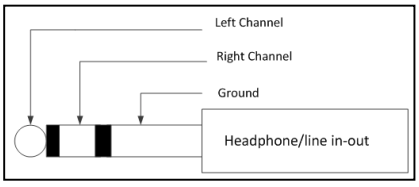
The Lin-In and both Line-out interfaces are stereo. The Mic-In interface is mono. It is not possible to use both line in interfaces at the same time. Only one is active at a time.

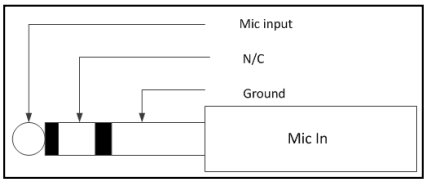
If you configure the audio board as “Line-In” only, the “Line-Out” interface is active. If you configure it as “Mic-In,” both line-out interfaces are active.

Specifications according to datasheet:

- Sampling rate 48kHz
- Resolution 16bit
- SNR Lin-In/Out 90db
- SNR Mic-In 80dB
- Frequency 20Hz – 20kHz

Jack 3,5mm, pin assignment





11 Supported resolutions

HDMI / DVI:
All resolutions up to 150 MHz pixel clock (1920 x 1080)

VGA:
640 x 480 @ 60 Hz/72 Hz/75 Hz/85 Hz
800 x 600 @ 56 Hz/60 Hz/72 Hz/75 Hz/85 Hz
1024 x 768 @ 60 Hz/70 Hz/75Hz/85 Hz
1280 x 1024 @ 60 Hz/75 Hz

SDI:
1080p60/30
1080p50/25
1080p24
720p60
720p50
720p30
720p25
720p24
1080i60
1080i50
1080s24
480i60
480i50
576i50

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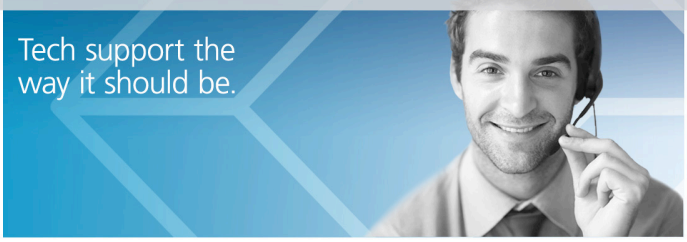

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